

## REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS n/a		
2a. SECURITY CLASSIFICATION AUTHORITY n/a			3. DISTRIBUTION/AVAILABILITY OF REPORT For Announcement Purposes Only		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE n/a			5. MONITORING ORGANIZATION REPORT NUMBER(S) A 90-02		
4a. NAME OF PERFORMING ORGANIZATION City Colleges, City University of New York			6b. OFFICE SYMBOL (If applicable) --		
4c. ADDRESS (City, State, and ZIP Code) City College, City University of New York 138th Street and Convent Avenue New York, NY 10031			7a. NAME OF MONITORING ORGANIZATION U. S. Army Research Institution for the Behavioral and Social Sciences		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION see 7a			8b. OFFICE SYMBOL (If applicable) PERI-BR		
8c. ADDRESS (City, State, and ZIP Code) see 7b			9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER MDA 903-82-C-0353		
			10. SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.
			6.11.02B	74F	n/a
			WORK UNIT ACCESSION NO. n/a		
11. TITLE (Include Security Classification) Anxiety and Cognitive Processing of Instruction					
12. PERSONAL AUTHOR(S) Sigmund Tobias					
13a. TYPE OF REPORT Announcement		13b. TIME COVERED FROM 82/09 TO 86/09		14. DATE OF REPORT (Year, Month, Day) 1990, July	
				15. PAGE COUNT 23	
16. SUPPLEMENTARY NOTATION Judith Orasanu, contracting officer's representative (cont. at # 19) Availability: in Schwarzer, S. (in press) <u>Self-Related Cognitions in Anxiety and Motivation</u>					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP	Anxiety Instruction		
			Learning Processing		
			Cognition		
19. ABSTRACT (Continue on reverse if necessary and identify by block number) <p>This article examines recent research on anxiety, in terms of a research model proposed after reviewing the effects of anxiety on learning from instructions. The model specifies the points at which anxiety on learning can be expected to affect learning. It is assumed that since learning is a process that is essentially cognitively mediated, anxiety can affect learning only indirectly, by affecting the cognitive processes mediating learning at various stages. The model separates the instructional process into the three classic information-processing components: input, processing, and output. The input component denotes presentation of instruction to students, processing represents all of the operations students use to encode, organize, and store input, and output designates student performance on any evaluative instrument after instruction. It was hypothesized that there are three points at which anxiety could affect learning from instructions most directly: in preprocessing, during processing, and after processing, but just before output.</p>					
16. Supplementary Notation (continued) Hillsdale NJ: Erlbaum					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL Judith Orasanu			22b. TELEPHONE (Include Area Code) 202/274-8722		22c. OFFICE SYMBOL PERI-BR

*In press*

Anxiety and Cognitive Processing of Instruction  
Sigmund Tobias  
City College, City University of New York

This paper formed the basis for an invited address at a conference on "Anxiety and Self-Related Cognitions" held at the Free University, Berlin, July, 1983. It is scheduled to appear as a chapter in R. Schwarzer (Ed.) "Self-Related Cognitions in Anxiety and Motivation." Hillsdale, New Jersey: Lawrence Erlbaum Association, in press.

Preparation of this paper was facilitated by a grant from the Basic Research Program of the Army Research Institute for the Behavioral And Social Sciences. The views and opinions expressed are those of the author and should not be construed as official, or as reflecting the views of the Department of the Army or the U.S. government.



<b>DISTRIBUTION STATEMENT A</b>
Approved for public release; Distribution Unlimited

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By <i>per form 50</i>	
Distribution/	
Availability Codes	
Dist.	Avail and/or Special
<i>A-1</i>	<i>21</i>

## Anxiety and Cognitive Processing of Instruction

Sigmund Tobias

City College,

City University of New York

The effects of anxiety on learning from instruction have been frequently demonstrated. Despite the robustness of this effect the number of studies of anxiety in the educational research and educational psychology literature in the United States has been relatively modest in the last two decades (Tobias, 1979). An analysis of the 1983 program of the American Educational Research Association, for example, reveals only a single session devoted to test anxiety, and none to the more general topic of anxiety. This deemphasis of anxiety research is probably attributable to the paradigm shift to a more cognitive psychology. Apparently in the last few years American psychology has been discovering its thoughts at the expense of its feelings. Recent attempts to reinterpret the construct of test anxiety entirely in terms of deficits in cognitive acquisition skills, to be reviewed in detail below, are consistent with this zeitgeist.

There are apparently national differences in interest regarding the relationship between test anxiety and achievement. Evidence of European activity in test anxiety research can be seen from the two volumes published by the European based International Society for Test Anxiety Research (Schwarzer, van der Ploeg, and Spielberger, 1982; van der Ploeg, Schwarzer, and Spielberger, 1983), from the recently completed convention of that Society in Leuven, Belgium, (1983) also to be published in book form, and from the present volume. European psychology was ahead of American psychology in displaying interest in existential psychology and in recognizing the importance of Piaget's contributions which led to a more cognitively oriented psychology. Perhaps the greater interest in anxiety of European researchers is a harbinger of things to come in American psychology as well.

There are signs that the deemphasis in American educational research regarding research on affect in general, and anxiety in particular may be coming to an end. Activity in this area is seen by a conference on "Affect and Cognition" subsequently published in book form (Clark & Fiske, 1982). A recent conference at Stanford University on the topic of "Aptitude, Learning, and Instruction: Conative and Affective Process Analyses" to be published subsequently (Snow & Farr, In press) is another sign of interest in this field. At that conference Sarason (In press) reviewed the relationship of test anxiety to cognitive interference in learning. Finally, contemporary analysis of people's cognitive processing, to be reviewed below,

provides evidence for interference by anxiety in the effective cognitive processing of instruction. It is, therefore, an opportune time to examine the state of knowledge regarding the effects of anxiety on the cognitive processing of instruction, and to attempt to suggest some new directions in this area.

### Research Model

It may be useful to examine the recent research on anxiety in terms of a research model proposed after a review of the effects of anxiety on learning from instruction (Tobias, 1977, 1979). The model specifies the points at which anxiety can be expected to affect learning. It is assumed that: "Since learning is a process that is essentially cognitively mediated, anxiety can affect learning only indirectly by impacting on the cognitive processes mediating learning at various stages" (Tobias, 1979 p. 575). The model, depicted in Figure 1, arbitrarily separates the

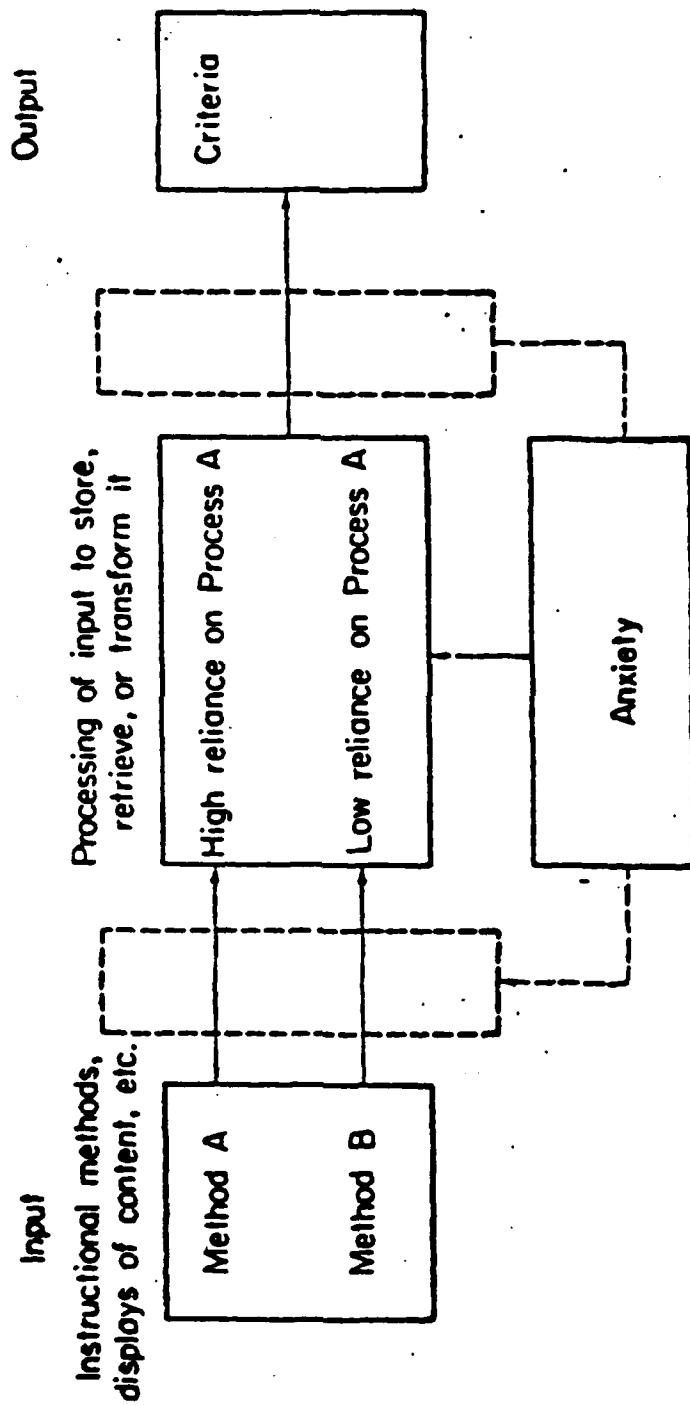
-----  
Insert Figure 1 about here  
-----

instructional process into the three classical information-processing components: input processing and output. The input component denotes presentation of instruction to students. Processing represents all the operations performed by students to encode, organize and store input. Output encompasses students' performance on any evaluative instrument after instruction. Some possible indirect ways in which anxiety can affect instruction are indicated by the broken lines in Figure 1. It was hypothesized that there are three possible points at which anxiety can affect learning from instruction most prominently: 1) preprocessing, 2) during processing and 3) after processing and just before output. Empirical support for the model is briefly reviewed below.

#### Preprocessing.

Sarason (1972) and Wine (1971) suggested that those high in anxiety divide their attention between task demands, and ruminations stimulated by high anxiety. Conversely those lower in anxiety learn more since they devote more of their attention to task demands and less to anxiety related preoccupations. Preprocessing interference suggests that while anxious students are occupied with off-task concerns such as worry, they may miss some proportion of instructional input. The diversion of attention to off-task concerns, then, interferes in learning by reducing the proportion of nominal input that becomes effective for high anxiety learners. Preprocessing interference is especially debilitating since any proportion of input not encoded cannot subsequently be processed.

The model hypothesizes that any procedure which permits students



to reinstitute input will reduce the potential interference of anxiety at this stage. Procedures such as being able to review segments of text, or having the option to rewind audio or video tapes are predicted to reduce preprocessing interference and, therefore, should be especially beneficial for the performance of high anxiety students. The performance of low anxious students is expected to be unaffected by these procedures.

Deutsch and Tobias (Note 1) tested this part of the model in a study in which students were assigned to view four video modules either individually, permitting review of the video tape, or in group form where such review was not possible. A significant interaction between test anxiety and the opportunity to review was obtained and is depicted in Figure 2. As expected, highly

-----  
 Insert Figure 2 about here  
 -----

anxious students who viewed the modules independently and had the opportunity to review learned more than anxious students who viewed the modules in groups without the review option. Furthermore, the differences in posttest scores between high and low anxiety students in the independent, review-possible condition were smaller than those in the group administered condition.

Further support for preprocessing interference came from a study by Tobias and Sacks (Note 2). Three groups read a text passage; of special interest was one group ( $n = 35$ ) which received adjunct questions concerning previously read text segments. Students in this group were informed that they could review preceeding text whenever they wished. Correlations between the number of reviews and the Worry Emotionality scale (Liebert & Morris, 1967), administered with instructions for subjects to respond in terms of the way they felt while reading the passage, were .54 with worry, and .41 with emotionality ( $p < .01$ ). Correlations between Worry Emotionality scales administered after the posttest and number of reviews were comparable: .54 with Worry and .40 with Emotionality. These results suggest that as anxiety increased students tended to review prior content more frequently, as predicted by the preprocessing formulaton. Presumably, highly anxious students tried to make up for some inattentiveness by reviewing preceeding text more frequently than their less anxious counterparts.

### Processing Interference

At this stage the model assumes that external instructional input has been encoded and subjected to cognitive processing. Here it was expected that three types of factors were likely to have important

5

# INDEPENDENTS

**POSTEST**

**GROUPS**

15-

20-

25-

30-

35-

12

19

26

**TAS**

effects on cognitive processing of instruction: difficulty, reliance on memory and task organization.

Difficulty . Research has shown repeatedly (Sieber, et al., 1977; Sarason, 1983) that anxiety is more debilitating to learning on difficult content than on easy material. Reducing the difficulty of material then, can, be expected to be differentially beneficial for anxious students.

Reliance on Memory . There is evidence suggesting that performance of highly anxious students is especially debilitated on tasks calling for short and intermediate term memory (Mueller, 1980). It is reasoned that for highly anxious students cognitive interference in processing reduces recall. Kreitzberg and Tobias (Note 3) provided evidence that anxiety interferes with the rehearsal required to maintain stimuli in short term memory. Sieber (1977) reported a number of investigations in which anxious students who had to rely on intermediate term memory performed less capably than their less anxious counterparts. The test anxiety-memory relationship will be re-examined below.

Organization . The model predicts that the presentation of well organized content will result in superior achievement for anxious students compared to those lower in anxiety. It is assumed that any manipulation which organizes instruction more effectively is expected to be differentially beneficial for highly anxious students.

#### Post Processing Interference .

This effect is meant to represent interference in the retrieval of previous learning, such as during a test. When the model was first proposed, (Tobias, 1977, 1979) it was indicated that there were no empirical studies in support of this type of interference, though students often "claimed to have studied dilligently yet 'freeze up' on tests" (p.576). In the last few years a number of studies have questioned the occurrence of post processing interference, and these will be discussed next.

#### Test Anxiety: Interference or Skills Deficit ?

A number of studies have been critical of the traditional interference model in which worry and other anxiety related ruminations are hypothesized to interfere with student performance during testing. The interference model implies that high and low anxiety students may have mastered the content on which they are to be examined to a comparable degree, but that retrieval of this previously acquired information by high anxiety students is debilitated by the cognitive interference experienced as a result of the evaluative threat posed by examinations (Sarason, In press, 1972; Wine, 1971,



1980)). Recent research has proposed a deficit model in which the debilitating effects on test performance can be attributable to either a study skills or test strategy deficit.

Study Skills Deficit . This interpretation suggests that high test anxious students may have poorer study skills than those lower in anxiety leading to less thorough initial learning. Poor posttest performance is, then, a function of the acquisition deficit and the observed elevation in anxiety is attributable to student's metacognitive (Flavell, 1979) awareness of their incomplete learning. In terms of the research model (Tobias, 1979), the study skills deficit formulation questions the existence of the post processing effect.

Test Taking Deficit . This formulation suggests that high test anxious students may have poorer test taking skills than those lower in anxiety leading to reduced test performance. Again, elevations in test anxiety may be a reflection of student's knowledge of their less effective test taking behavior.

#### Review of Research on the Deficit Model

A number of studies examined the relationship between test anxiety and study skills. The impetus for this research probably came from frequent findings, summarized by Allen, Elias, and Zlotlow (1981), by Denney (1981), and by Tobias (1979), that "a very large percentage of (test anxiety reduction) programs succeed in reducing student's anxiety as determined by a variety of self-reported measures. A decidedly smaller percentage of outcome studies has found that the symptomatic reductions are accompanied by an improvement in scholastic or cognitive performance indices" (Tobias, 1979, p.580).

Desiderato and Koskinen (1968) and Wittmaier (1972), using Alpert and Haber's (1960) Achievement Anxiety Test, found that anxious students had less effective study skills than those lower in anxiety. After a similar study Mitchell and Ng (1972) concluded that "a reduction in test anxiety is no guarantee of subsequent improvement in academic performance when the level of study habit competence is ignored" (p.496). Allen (1971) reached similar conclusions.

Culler and Holahan (1980) found that high, compared to low test anxious subjects had significantly poorer study habits and spent more time studying. They also found that "high test-anxious students who had developed and exercised better study skills did better academically than those with poor study habits .... The findings .... tend to contradict the common stereotype of the high test-anxious student who knows the subject matter but 'freezes up' at test time" (p.18). Student's study time per week was significantly correlated with the GPA for the high test-anxious group but not the low, suggesting that anxious students may compensate for poor skills by

studying more hours. The superior study skills of low-anxious subjects may reduce the importance of study time.

Kirkland and Hollandsworth (1979) found that test anxiety scores correlated significantly with the total score of Brown's (1975) Effective Study Test. Three of five subtests had significant correlations with test anxiety. The Achievement Anxiety Test also correlated significantly with total study skills score. When grade point average was a criterion in a step-wise multiple linear regression analysis only the difference score between facilitating and debilitating anxiety and the Examination Behavior Scale added significant variance above that accounted for by scholastic aptitude. These writers "raise the question whether anxiety interferes with effective test-taking behavior or whether the lack of effective skills results in anxiety" (p.435).

Benjamin, McKeachie, Lynn and Holinger (1981) found that high test anxious subjects had significantly poorer multiple choice (considered a storage index) and fill-in (considered a retrieval index) test scores than those lower in anxiety. Highly anxious students had lower scores on the fill-in than on the multiple choice test. In an analysis of covariance, with fill-in scores as the covariate and multiple choice scores as the dependent variable, performance differences between high and low anxiety students disappeared. These results were interpreted to suggest that retrieval, as measured by short answer fill-in exams, appeared to be more of a problem for test anxious students than storage and encoding of the information. High anxiety students also reported significantly more problems both in learning and in reviewing, and spending more study time the week before, and the last 24 hours before an exam, supporting the findings of Culler and Hollahan (1980).

In a second study Benjamin et al found differences between high and low anxiety students on essay, short answer and take home exams, but not on multiple choice tests. On a study habits questionnaire high test anxiety students did not differ from those lower in anxiety on delay avoidance items, but reported more difficulty picking out important information. In general, the higher the test anxiety the greater the problems reported in initial learning, in reviewing, and in remembering on examinations. Furthermore, high test anxiety students reported spending more time studying during the last week before a final exam. The authors propose a causal sequence in which lower ability may lead to achievement anxiety which, in turn, leads to less effective study habits, less effective processing of input, and poorer test performance.

Wendell and Tobias (Note 4) administered tests shortly after learning and again before an exam approximately 3 1/2 weeks later - to differentiate between acquisition and retrieval mechanisms. A total of 84 students in educational psychology classes watched six televised modules dealing with course relevant content. A pretest was given immediately before each module and readministered after its completion. A summative posttest, containing all the items of the

six module tests, was presented later. As expected, significant negative correlations between test anxiety and both immediate module posttests and the delayed summative test were found.

Wendell and Tobias computed several derived scores. One of these, abbreviated as "Fail-Pass-Fail", consisted of items which the students failed on pretest, passed on posttest immediately after the module and failed on the summative posttest administered later. A second derived score, "Pass-Pass-Fail", consisted of items passed on both pre-, and immediate posttest and failed on summative posttest. These two scores were expected to serve as a retrieval index of previous learning since they were composed of items passed immediately after the module, and failed three weeks later when that information had to be retrieved from long-term memory. Positive correlations between TAS and these indices were expected since high anxiety was expected to be related to the greater incidence of retrieval difficulties.

The results, presented in Table 1, yielded conflicting evidence.

-----  
 Insert Table 1 about here  
 -----

The correlation between the TAS and one retrieval index, Pass-Pass-Fail score was .22, ( $p. \leq .05$ ). The other retrieval index yielded nonsignificant results. The positive correlation between TAS and the third derived score Fail-Fail-Pass, was unexpected. One might speculate that anxious students may have been more aware of missed items and spent more time studying prior to the summative post test, accounting for this unexpected result.

There are a number of difficulties with the Wendell and Tobias investigation. First the indices used were change scores and subject to the well known reliability problems of such measures (Thorndike, 1963). A second problem was the fact that the module posttests included items dealing with content from the beginning, middle, and end of the modules. Since an average of about 35 minutes was required to view the modules and the test was administered at their conclusion, students may have been responding to material covered more than half an hour ago on some items. Module posttests were considered to tap working memory, while the delayed posttest was expected to measure recall from long-term memory. Since, however, some proportion of the content tapped by test items may have been acquired over half an hour earlier, many items can be conceived of as tapping long term memory at two different points in time.

In a study of test-taking skills deficit Kirkland and Hollandsworth (1980) compared a skills acquisition approach which placed no emphasis on anxiety reduction, to several anxiety reduction techniques. The skills acquisition treatment resulted in improvements in academic performance, while the two anxiety reduction techniques did not. On an anagram test, the skills acquisition group

Table 1

Table 1. Means, SDs, Number of Cases and Correlation with TAS for selected Variables.

	Modules 1-6 Combined		Delayed Posttest	Fail		Pass		Fail	
	Pretest	Posttest		Pass	Fail	Pass	Fail	Pass	Fail
N	78	78	73	73	73	73	73	73	73
Mean	2.93	5.95	6.68	4.30	4.30	.98		9.37	
SD	.78	1.64	1.59	2.78	2.78	1.05		4.05	
r	-.35*	-.40*	-.28*	.13	.13	.22*		.33*	

10

(From Wendell and Tobias, Note 4)

\*p < .05

solved more problems under stress-inducing conditions than students from the other groups, and these subjects also reported more knowledge of effective test taking behavior. These results led the authors to speculate that "perhaps it is time to give the phrase test anxiety a respectful burial and talk about inadequate test performance in terms that more accurately describe what it is, namely ineffective test taking" (p. 438).

In an investigation presently underway (Note 5), we examined whether test anxiety affected acquisition, retrieval, or the employment of learning strategies. Students studied two lists of words for 30 seconds per trial. Each list was composed of three equal categories. Subjects studied the first list to a criterion of one perfect repetition, but the second list was exposed only three times. When both lists were completed, four scales of Weinstein's (Note 6) Learning and Study Skills Inventory were administered, and students were then asked to recall the preceding lists. Sarason's (1972) Test Anxiety Scale had been administered previously, and the Worry-Emotionality (Liebert & Morris, 1967) scales were administered at three points: at the beginning, after List 1, and again after delayed recall.

It was reasoned that these procedures formed an analog to situations in which students learned various content in different courses which then competed with one another in recall. Words recalled from List 1 were considered an index of retrieval from long-term memory since the words were learned perfectly. For the second list, recall was divided into an additional category: words remembered on immediate recall but failed on delayed recall (Pass-Fail).

Preliminary results for 38 students were available. Multiple linear regression analyses computed on these preliminary data indicate that anxiety, (TAS, Worry and Emotionality) and study skills determined by four subscales of Weinstein's test (Information Processing and Elaboration, Concentration, Selecting Main Ideas, and Self Testing) had surprising by weak effects on acquisition and retrieval indices for List 1. Stronger effects for both study skills and anxiety were found for List 2. More definitive data on this study will be available shortly.

The preliminary results suggest that in a powerful learning treatment such as that used in List 1, where perfect recall was required, neither anxiety nor study skills was strongly related to learning. On the other hand on List 2, which was exposed only three times and for which perfect recall was not required, both anxiety and study skills were related to dependent variables. Apparently, when learning stops short of mastery anxiety and study skills are of some importance in both acquisition and delayed recall. When instruction leads to mastery, neither is terribly influential. Finally, the results suggest that study skills and anxiety have joint effects, and neither can be said to be capable of standing in for the other. Of course, these results should be considered highly tentative,

subject to the completion of the study.

### Macroprocesses and Instruction

It has been hypothesized that "the most important variable(s) accounting for learning from instruction (are) macroprocesses, or the frequency and intensity with which students cognitively process instructional input" (Tobias, 1982, p. 5). A number of studies dealing with macroprocesses relevant to test anxiety have been conducted in classroom contexts and will be discussed below. Other studies utilizing computers to keep track of student's processing of instruction (Tobias, Note 7) are presently underway.

Peterson, Swing, Stark and Waas (Note 8) examined the macroprocesses of minority students from two fifth grade classes. Mathematics lessons were videotaped, and students then interviewed regarding their cognitive processes during the lesson. Of special relevance to anxiety was a category called "Students' Affective Thought," which was divided into subsidiary categories. A number of affective categories were discarded for lack of relationship with dependent measures including both anxious thoughts and task oriented thoughts aimed at getting the correct answers.

The most frequently reported category of affective thoughts in Peterson et al's (Note 8) study represented student's concern with getting the problems right. This category included statements like the following: "(I was thinking) how to get them right and how to count em right" (p. 18). In contrast, the least frequently reported affective thoughts consisted of expressions of worry and anxiety which included statements like the following: "I was kinda nervous and felt kinda funny" (p. 18). Despite their infrequency, the category "negative evaluation of self" had significant correlations with achievement raw score ( $r = -.24$ ), and with percent correct of total attempted ( $r = -.26$ ). Some examples of negative self thought were: "I thought I was going to get them wrong," "I was having trouble understanding: I wasn't too quick on the answers, so other people beat me to 'em before I could get my hand up." Since negative self thoughts were unrelated to scores on standardized achievement tests, their negative relationship with achievement was independent of student's mathematics ability.

Rohrkemper, McCauley and Slavin (Note 9) interviewed a total of 66 third to sixth grade students from an inner city school system about their cognitive activities while participating in mathematics instruction. They found efficacy statements to be the second most frequently occurring type of self report. These statements dealt with the difficulty of the task and expected success or failure. Most efficacy statements occurred early in students' task engagement, and 21 of 29 statements were negative in tone, for example, "If I don't get this right I will maybe fail. Then I start to scribble on my paper" (p.7). Another category, affective reactions, was the least characteristic of student's speech, but all reported statements were

negative, for example, "I say I hate myself". While Rohrkemper et al did not conceptualize their study with respect to anxiety two of their categories, negatively toned efficacy statements and affective reactions, appeared to have strong resemblance to the negative preoccupations reported as characteristic of high test anxiety students (Wine, 1971; Sarason, 1972, In press).

Peterson et al (Note 8) reported that verbalizations of worry and anxiety were infrequent, though significantly related to outcome measures. Their most frequently reported category had a strong resemblance to the efficacy statements reported in Rohrkemper et al study (Note 8). On the basis of the examples given, it would appear that some of the cognitions reported in both studies were similar to cognitive interference reported by high test anxiety students. If, in fact, Peterson's category of "student's concern with getting the problems right" does include anxiety related cognitions, then, when these are combined with the overtly anxious verbalizations, concerns with getting the answer right and fears of failure appear to occur relatively frequently during classroom instruction. Rohrkemper et al's data also suggest that when two frequently occurring categories (negative efficacy statements and infrequent affective reactions) are combined cognitive thoughts similar to those of test anxious students take up a large percentage of student's cognitive activity during instruction. The fact that these cognitions were unrelated to mathematics ability (Note 8) suggests that arithmetic skill deficits are not prominent components of these verbalizations.

Weinstein, Cubberly, and Richardson (1982) induced high and low anxiety subjects to use either a superficial or a deeper processing strategy in a paired associate learning task. They found an interaction between processing strategy and anxiety indicating little difference between high and low anxious groups on superficial levels of processing, but a significant difference favoring low test anxious subjects at a deeper level of processing. It was suggested that high anxiety students may be unable "to handle the processing requirements of the task at the same time they are attending to and processing the cognitions associated with worry (p 111).

Muller and Courtois (1980) studied the relationships between anxiety and broad as opposed to narrow and encoding of word lists. It was reasoned that highly anxious students normally encode words in a narrow manner, hence, instruction to encode broadly should facilitate performance. Conversely, the performance of low anxious was expected to decrease with narrow encoding instructions, since such students were expected to use a broad encoding strategy routinely. The anxiety groups, in general, recalled fewer words in both immediate and delayed recall. Narrow encoding did interfere with performance of low anxious students, though those high in anxiety did not benefit from broad encoding treatment. It was reasoned that, either, the encoding instruction were effective, or that high anxious students may not customarily switch from one memory strategy to another as readily as those lower in anxiety.

### Test Anxiety: Interference, Retrieval and Information Processing Capacity

Several of the investigations, reviewed above, questioned the utility of the test anxiety construct and interpreted these phenomena as deficits in test taking or acquisition skills. In terms of Tobias' model (1979) these studies question the occurrence of post processing effect and suggest that the interference occurs either at preprocessing, or during processing. The researchers are, apparently, divided regarding whether they accept anxiety as a cause of interference at these prior stages, or simply attribute the acquisition deficit to a failure in learning. Benjamin et al (1981), would apparently accept a role for anxiety in their model, the other writers probably not. In any event there appear to be several problems with the deficit formulation.

The deficit hypothesis assumes that students who are poorly prepared for an examination have elevations in test anxiety caused by their metacognitive awareness of inadequate mastery. This explanation makes it difficult to understand the research reports, (Benjamin, et al., 1981; Culler and Hollahan, 1980) of students with good study skills who are also highly test anxious. If the deficit formulation is accurate, such students should have little to be anxious about since their test anxiety scores cannot be explained by either study or test taking skills deficits. Apparently, something other than skills deficit must be invoked to explain the anxiety scores of such students.

The deficit formulation also makes it difficult to understand why anxiety reduction programs succeed in reducing anxiety without increasing cognitive performance. If high test anxiety is caused by student's awareness of inadequate test preparation, the reduction in test anxiety is difficult to understand. Since performance has not improved anxious students should, according to the deficit rationale, continue to be anxious after these treatment programs since they are as poorly prepared as before. While it is possible to maintain that such programs merely teach students to feel better, these more positive feelings cannot be attributed to perceived mastery. Presumably, then, reduced negative affect must be related to other, unspecified sources.

Finally, the correlations between study skills and anxiety appear to account for less than 10% of the variance. Kirkland and Hollandsworth (1979) reported a correlation of  $-.26$  between test anxiety and total study skills score. Since approximately 93% of the common variance of these constructs is unaccounted for it appears unwise to suggest that either of these variables can wholly replace the other.

The problems discussed above suggest that neither the



interference nor the deficit formulation alone are adequate to account for the research results. The most reasonable interpretation of the available evidence is that the lower performance of test anxious students may be attributed to both on interference and a skills deficit problem. It may be useful to reconceptualize these phenomena in terms of information processing capacity.

### Information Processing Capacity

Broadbent's (1958, 1971) formulation that humans have a limited capacity information processing system provides a useful point of departure by which both the interference and deficit interpretations can be conceptualized. Whether the negative affective preoccupations associated with test anxiety are seen as the result of poor test preparation, or as the result of a fear of failure, there is ample evidence (Wine, 1971; Sarason, 1972) that such students have elevations of affect characterized by unfavorable self-perceptions, and related negative self-preoccupations. The cognitive representation of such preoccupations, must absorb some portion of the person's information processing capacity leaving less capacity for coping with task demands. This conceptualization is similar to that proposed by Hamilton (1975).

The capacity formulation clarifies a number of classical findings in the test anxiety literature whether attributable to interference or skills deficit. Thus, it has often been observed (Tobias, 1980; Wine, 1980; Sarason, in press) that the performance of students preoccupied with negative self-preoccupations is most debilitated on difficult tasks and least affected on easy tasks. Difficult tasks, of course, require more processing than easier ones. When cognitive capacity is partially engaged by negative self-preoccupations less capacity is available for the demands of difficult tasks, thus reducing learning. Easier problems, on the other hand, require a smaller proportion of students' cognitive capacities, hence successful performance on such tasks can occur despite affective interference.

The present analysis, then, would suggest that two types of events would reduce interference in performance: 1) Reducing the processing capacity absorbed by affective preoccupations, or 2) reducing the information processing demands of the task. The findings (Wine, 1980, Sarason, In press) that reassuring students improves their performance indicates that the cognitive capacity tied up by such rumination is reduced when students are reassured regarding their performance on the task, or their abilities to solve the task. Second, the findings that even relatively trivial manipulations, such as suggesting to students that they concentrate more on the task and less on extraneous matters, improves performance (Wine, 1980, Sarason, In Press) can be similarly interpreted. Such instructions enable students to devote a greater proportion of processing capacity to the task, and less to anxious self-ruminations. The enhancement of performance is, of course, attributable to having more cognitive

capacity available for task solution.

The second way to improve the performance of students with negative affective preoccupations is to reduce the information processing demanded by tasks. The type of manipulations suggested previously (Tobias, 1977, 1979,) such as increasing the organization of instructional content, reducing its difficulty, and decreasing reliance on memory are likely to reduce the processing capacity required resulting in improved performance, especially by students whose processing capacity is partially allocated to off-task concerns.

It can be hypothesized that good study skills also have the effect of reducing the information processing demands of tasks. Students who relate new information to prior cognitive structures, effectively concentrate on the task at hand, and maintain ongoing metacognitive awareness of task performance probably require less information processing capacity for tasks, than those who are less effective in the utilization of these study skills. The latter probably rely more on actively rehearsing information in short term memory and similar strategies which absorb a greater proportion of cognitive capacity.

This formulation clarifies the relationship between test anxiety and study skills. Interference by anxiety and employing poor study skills both reduce performance, though for somewhat different reasons. High test anxiety may reduce performance by absorbing a large proportion of information processing capacity, leaving a reduced amount for task solution. Poor study skills, on the other hand, are hypothesized to interfere with performance by increasing the proportion of cognitive capacity required for task solution. Obviously, then, students with high anxiety and poor study skills would be the least effective learners since a large proportion of processing capacity is tied up with anxious ruminations, and task solution makes high demands on processing capacity. Conversely, students low in test anxiety with strong study skills will perform most effectively since little capacity is absorbed by off-task concerns, and good study skills reduce the amounts of processing required for learning. The performance of students with high test anxiety and good study skills or, those with low test anxiety and poor study skills is expected to be in the middle of the two extreme groups.

The research results and the information processing model suggest that at present, it is most prudent to view test anxiety from the joint perspective of both interference and skills deficit. It is possible to view the research supporting the deficit interpretation as an attempt to identify the cognitive processes mediating the effect of anxiety on performance. As suggested in Tobias' model (1977, 1979) affective states can impact on cognitive performance only indirectly by engaging the cognitive variables controlling that performance. It seems altogether reasonable that deficits in study and test taking skills may be one important component accounting for the observed

reduction in learning as a result of anxiety. The research on study skills, then has enlarged our understanding of the variables affecting learning from instruction. The cause and effect chain regarding whether affect is a consequence of cognitive deficit, or causes cognitive deficit is of some theoretical interest, and certainly warrants further investigation.

It is interesting to note that the attempt to identify the cognitive processes accounting for the test anxiety effect is similar to research paradigms in other areas. Thus, there has been a great deal of research activity in the last decade to identify the cognitive processes accounting for intelligence. Researchers in a variety of laboratories (Sternberg, 1981; Hunt, 1978; Snow, 1980; Pellegrino and Glaser, 1980) have been directed towards clarifying the specific cognitive processes of which intelligence is made up. Similar attention has been devoted to the clarification of other cognitive constructs, and some affective ones, such as motivation (Graham & Weiner, In press). It is, therefore, not surprising to see the beginnings of similar research devoted to the cognitive processes by which anxiety affects human performance.

Identifying study and test taking skills as cognitive components of test anxiety is, of course, only a beginning. An important question to be answered by such research deals with the possibility of training subjects to overcome the deficits, and to determine the degree to which this training is generalizable. Some preliminary results (Winne, Note 10) have indicated that training students in particular cognitive strategies so that they can maximize their learning from instruction may well be effective for a particular task, but have limited generalizability. Weinstein (1983) is studying the degree to which study skills training generalizes to new situations. These concerns are likely to lead to a clearer identification of the variables, associated with the reduction in performance observed in relationship to test anxiety. In addition, such research will clarify the cognitive construct by which people learn from instruction.

## Reference Notes

1. Deutsch, T., & Tobias, S.  
Prior achievement, anxiety, and instructional method. Paper presented at the annual convention at the American Psychological Association, Montreal, September 1980.
2. Tobias, S., & Sacks, J.  
Aptitude treatment interactions, adjunct questions, review and macroprocesses. Paper presented at the annual convention of the Northeastern Educational Research Association, Ellenville, N.Y., October, 1983.
3. Kreitzberg, C., & Tobias, S.  
Test anxiety, attention, and short term memory. Paper presented at the annual meeting of the American Psychological Association, New York, September, 1979.
4. Wendell, A., & Tobias, S.  
Anxiety and the retrieval of information from long term memory. Paper presented at the annual convention of the Northeastern Educational Research Association, Ellenville, N.Y., October, 1983.
5. Tobias, S. Test anxiety and post processing interference. In preparation.
6. Weinstein, C.E. Learning and study strategies inventory. (Mimeo). Austin, Texas: University of Texas, 1983.
7. Tobias, S. Macroprocesses and adaptive instruction. Paper presented at the annual convention of the American Educational Research Association, Montreal, April 1983.
8. Peterson, P.L., Swing, S.R., Stark, K.D., & Waas, G.A.  
Students' reports of their cognitive processes and affective thoughts during classroom instruction. Paper presented at the annual meeting of the American Educational Research Association, Montreal, April 1983.
9. Rohrkemper, M., McCauley, K., & Slavin, R.E.  
Student cognition study: Investigating students' perceptions of cognitive strategies as learning tools. Paper presented at the annual meeting of the American Educational Research Association, Montreal, April 1983.
10. Winne, P.H.  
Matching students' processing to text with instructional objectives or adjunct questions. Burnaby, B.C.: Simon Fraser University, Instructional Psychological Research Group, 1982.

## References

- Allen, G.J. The behavioral treatment of test anxiety: Recent research and future trends. Behavior Therapy, 1972, 3, 252-262.

- Allen, G.J., Elias, M.J., & Zlotlow, S.F. Behavioral interventions for alleviating test anxiety: A methodological overview of current therapeutic practices. In J.G. Sarason (Ed.), Test Anxiety: Theory, research and applications. Hillsdale, N.J.: Erlbaum, 1980.
- Alpert, R., & Haber, R. Anxiety in academic achievement situations. Journal of Abnormal and Social Psychology, 1960, 61, 207-215.
- Benjamin, M., McKeachie, W., Lin, Y., & Holinger, D. Test anxiety: Deficits in information processing. Journal of Educational Psychology, 1981, 73, 816-824.
- Brown, W.F. Effective study test : Manual of directions. San Marcos, Tex.: Effective Study Materials, 1975.
- Clarke, M.S. & Fiske, S.T. Affect and cognition: Hillsdale, N.J.: Erlbaum Associates, 1982.
- Culler, R.E., & Holahan, C. Test taking and academic performance: The effects of study-related behaviors. Journal of Educational Psychology, 1980, 72, 16-20.
- Denney, D.R. Self-control approaches to the treatment of test anxiety. In I.G. Sarason (Ed.), Test anxiety :Theory, research applications. Hillsdale, N.J.: Erlbaum, 1980.
- Desiderato, O., & Koskinen, P. Anxiety, study habits, and academic achievement. Journal of Counseling Psychology, 1969, 16, 162-165.
- Graham, S., & Weiner, B. Thinking-feeling-action sequences in instruction. In R.E. Snow and Farr (Eds.), Aptitude, learning, and instruction: Conative and affective process analyses. Hillsdale, N.J.: Erlbaum, in press.
- Hamilton, V. Socialization anxiety and information processing: A capacity model of anxiety-induced performance deficits. In I.G. Sarason and C.D. Spielberger (Eds.) Stress and Anxiety, Vol. 2, N.Y: Halstead Press, 1975.
- Hunt, E.B. Mechanics of verbal ability. Psychological Review, 1978, 85, 109-130.
- Kirkland, K., & Hollandsworth, J. Effective test taking: Skills-acquisition versus anxiety-reduction techniques. Journal of Counseling and Clinical Psychology, 1980, 48, 431-439.
- Kirkland, K., & Hollandsworth, J. Test anxiety, study skills, and academic performance. Journal of College Personnel, 1979, 431-435.

- Liebert, R.M., & Morris, L.W. Cognitive and emotional components of test anxiety: A distinction and some initial data. Psychological Reports , 1967, 20 , 975-978.
- Mitchell, K., & Ng, K. Effects of group counseling and behavior therapy on the academic achievement of test-anxious students. Journal Counseling Psychology , 1972, 19 , 491-497.
- Pellegrino, J. W., & Glaser, R. Components of inductive reasoning. In R.E. Snow, P.A. Federico, & W. Montague (Eds.), Aptitude, learning and instruction: Cognitive processes analysis (Vol. 1) . Hillsdale, N.J.: Erlbaum, 1980.
- Sarason, I.G. Experimental approaches to test anxiety: Attention and the uses of information. In C.D. Spielberger (Ed.), Anxiety: Current trends in theory and research (Vol. 2). New York: Academic Press, 1972.
- Sarason, I.G. Test anxiety, cognitive interference and performance. In R.E. Snow and Farr (Eds.), Aptitude, Learning, and instruction : Conative and affective process analyses . Hillsdale, N.J.: Erlbaum, 1980.
- Schwarzer, R., van der Ploeg, H.M., Spielberger, C.D. Advances in test anxiety research (Vol. 1). Hillsdale, N.J.: Erlbaum, 1982.
- Sieber, J.E. A paradigm for research on treatments designed to modify anxiety or its effects. In Sieber, J.E., O'Neil, H.F. Jr., & Tobias, S. Anxiety, learning, and instruction. Hillsdale, N.J.: Erlbaum Associates, 1977.
- Snow, R.E. Aptitude processes. In R.E. Snow, P.A. Federico, & W.E. Montague (Eds.), Aptitude, learning and instruction: Cognitive processes analysis. Hillsdale, N.J.: Erlbaum, 1980.
- Snow, R.E., & Farr, J. Aptitude, learning, and affective process analyses . Hillsdale, N.J.: Erlbaum, in press.
- Sternberg, R. Nothing fails like success: The search for an intelligent paradigm for studying intelligence. Journal of Educational Psychology , 1981, 73 , 142-155.
- Tobias, S. A model for research on the effect of anxiety on instruction. In J.E. Sieber, H.F. O'Neil, Jr., & S. Tobias, Anxiety, learning, and instruction . Hillsdale, N.J.: Erlbaum, 1977.
- Tobias, S. Anxiety research in educational psychology. Journal of Educational Psychology , 1979, 71 , 573-582.

Tobias, S. When do instructional methods make a difference.  
Educational Researcher , 1982, 4-9.

Thorndike, R.L. The concept of overachievement . New York:  
Teachers College Press, Columbia University, 1963.

van der Ploeg, H.M., Schwarzer, R., & Spielberger, C.D.  
Advances in test anxiety research (Vol. 2). Hillsdale, N.J.: Erlbaum,  
1983.

Wine, J.D. Cognitive-attentional theory of test anxiety. In I.G.  
Sarason (Ed.), Test anxiety : Theory , research, applications .  
Hillsdale, N.J.: Erlbaum, 1980.

Wine, J. Test anxiety and direction of attention.  
Psychological Bulletin , 1971, 71 , 92-104.

Wittmaier, B. Test anxiety and study habits.  
Journal of Educational Research , 1972, 352-354.